FIG.1

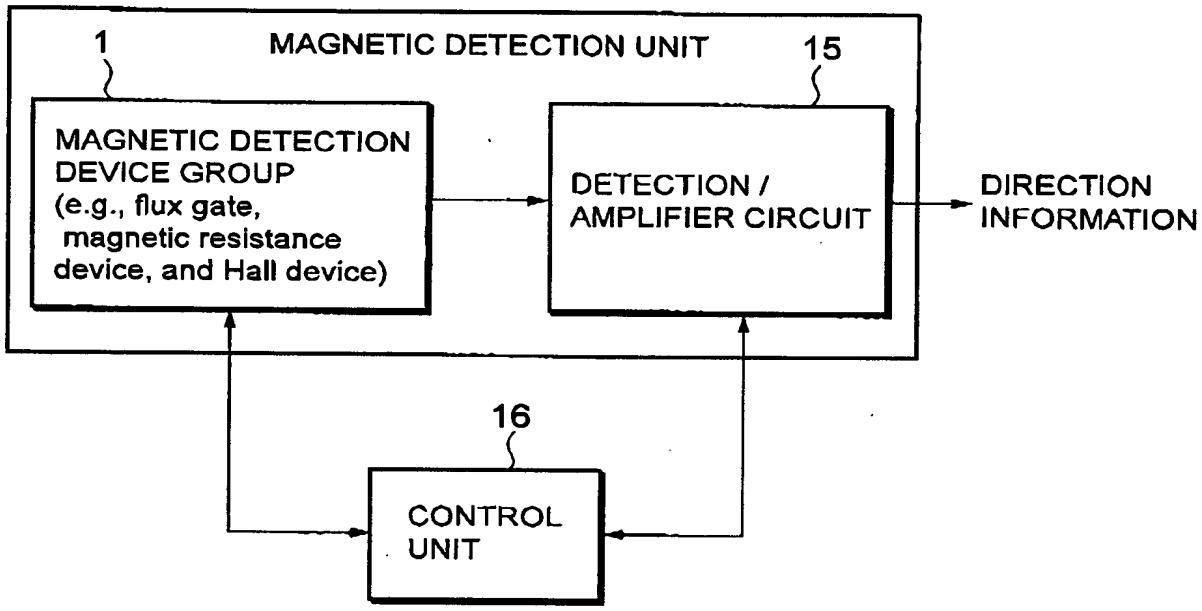

1
MAGNETIC DETECTION UNIT
15
MAGNETIC DETECTION DEVICE GROUP (e.g., flux gate, magnetic resistance device, and Hall device)
DETECTION / AMPLIFIER CIRCUIT
DIRECTION INFORMATION
16
CONTROL UNIT

FIG.2

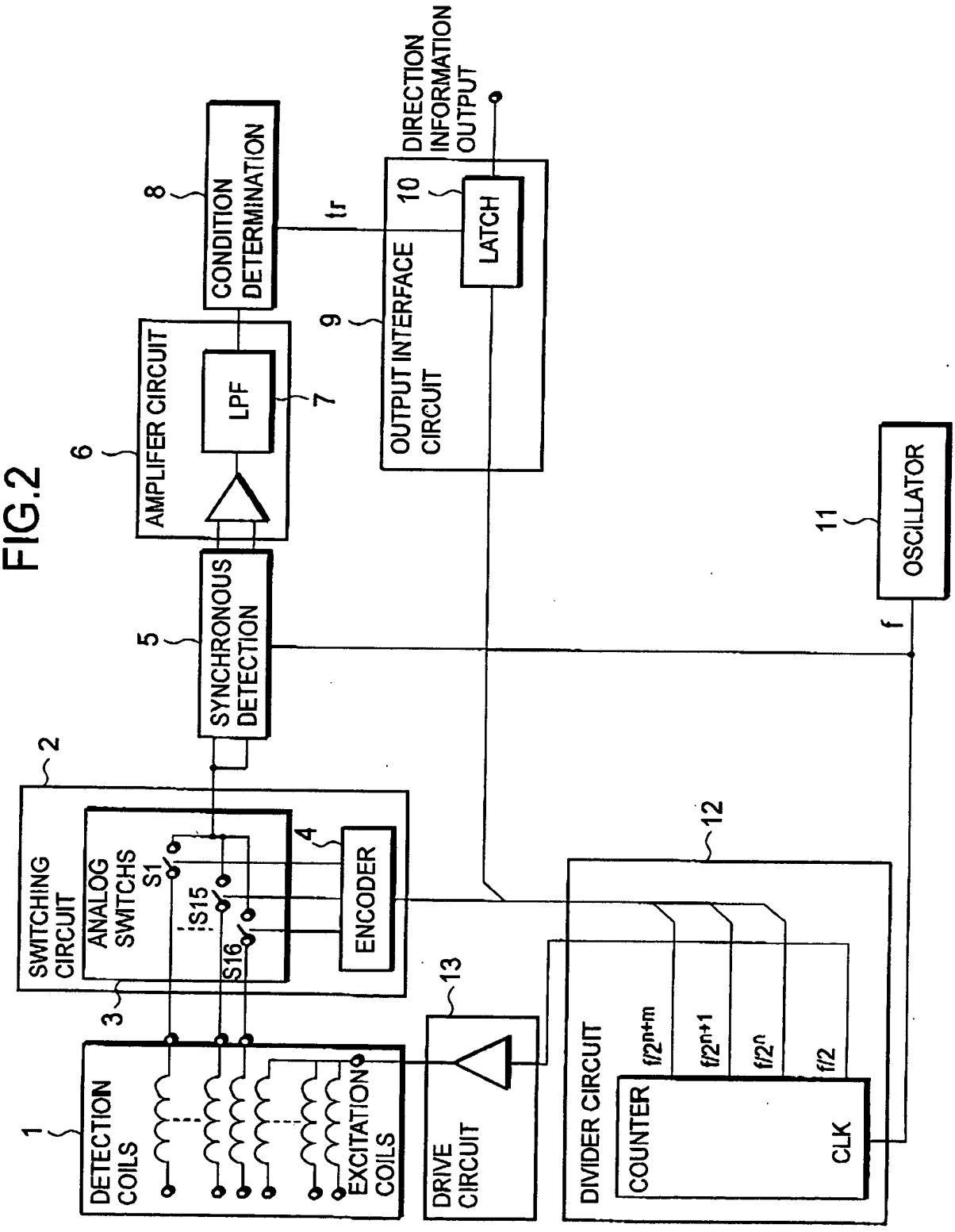

1
DETECTION COILS
EXCITATION COILS
2
SWITCHING CIRCUIT
ANALOG SWITCHS
S1
S15
S16
3
4
ENCODER
5
SYNCHRONOUS DETECTION
6
AMPLIFER CIRCUIT
LPF
7
8
CONDITION DETERMINATION
tr
9
OUTPUT INTERFACE CIRCUIT
10
LATCH
DIRECTION INFORMATION OUTPUT
11
OSCILLATOR
f
12
DIVIDER CIRCUIT
COUNTER
f/2^n+m
f/2^n+1
f/2^n
f/2
CLK
13
DRIVE CIRCUIT

FIG.3

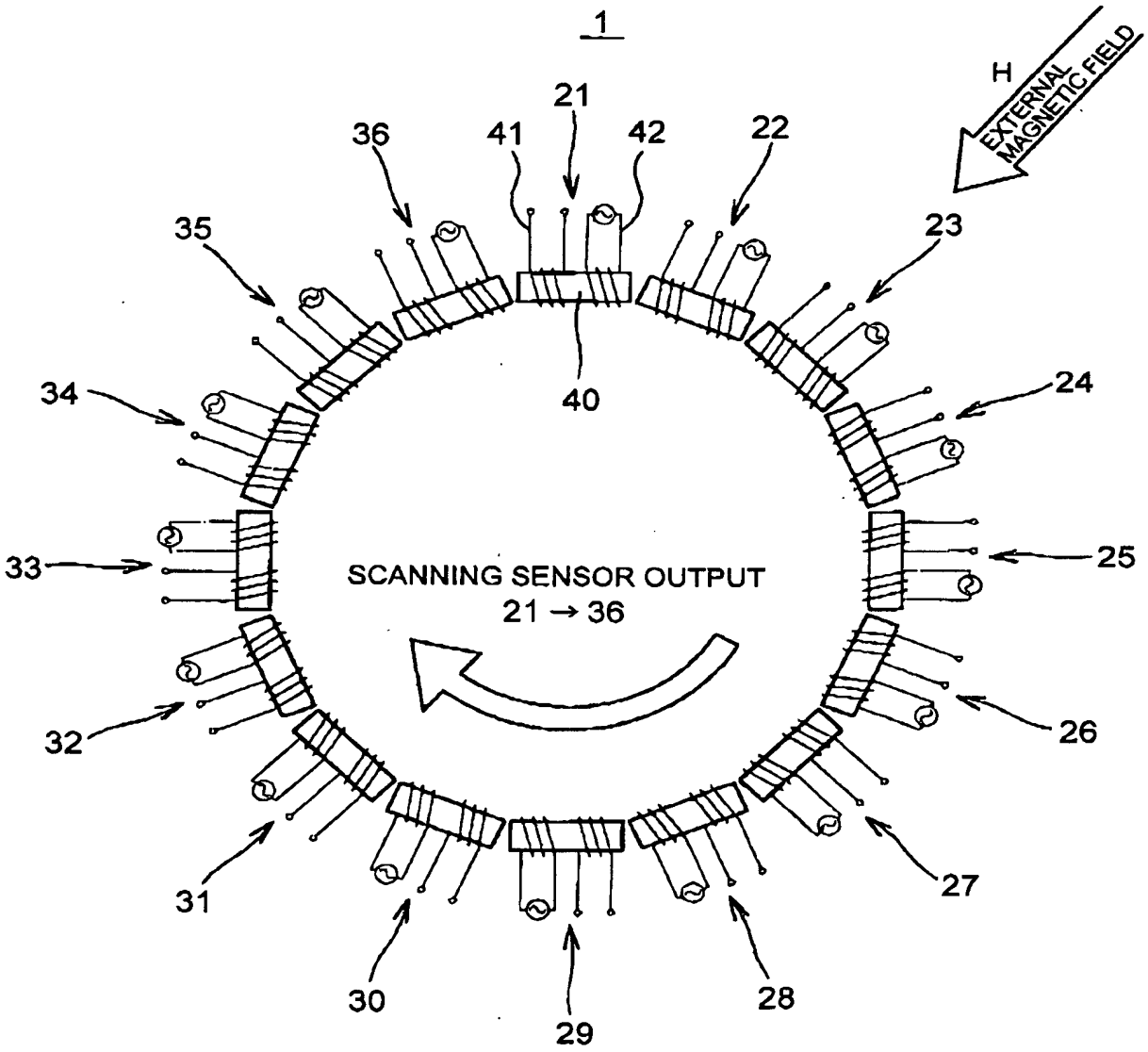

1
H
EXTERNAL MAGNETIC FIELD
21
36
41
42
22
35
23
40
34
24
33
25
SCANNING SENSOR OUTPUT
21 → 36
32
26
31
27
30
29
28

FIG.4

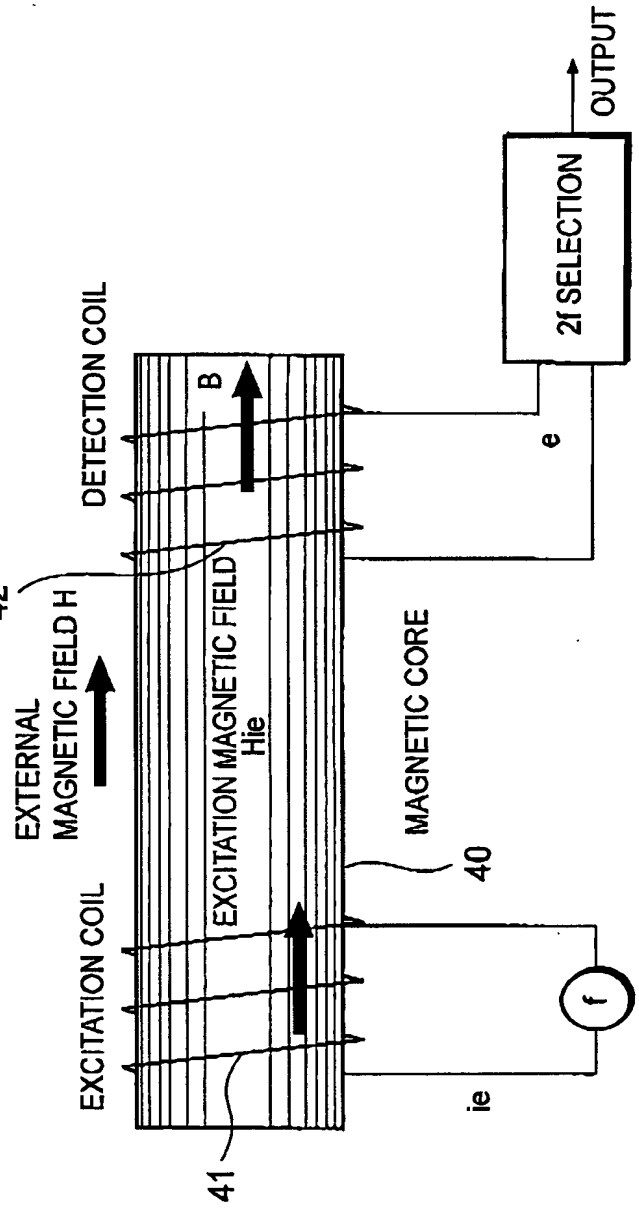

OUTPUT
2f SELECTION
e
DETECTION COIL
B
42
EXTERNAL MAGNETIC FIELD H
EXCITATION MAGNETIC FIELD Hie
MAGNETIC CORE
40
EXCITATION COIL
f
ie
41

FIG.5

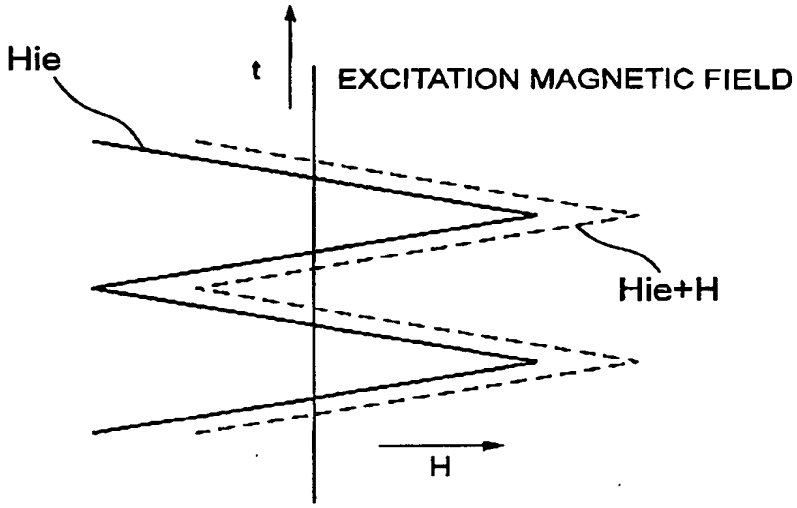

Hie
t
EXCITATION MAGNETIC FIELD
Hie+H
H

FIG.6

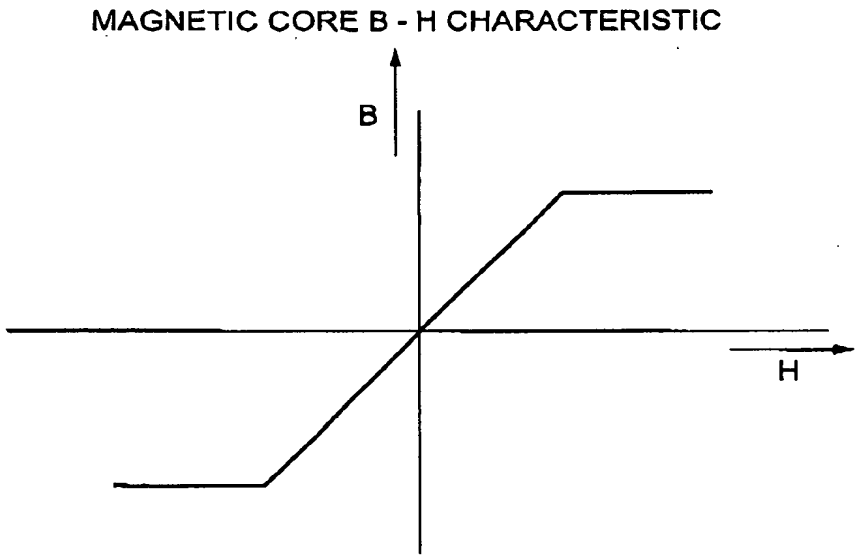

MAGNETIC CORE B - H CHARACTERISTIC
B
H

FIG.7

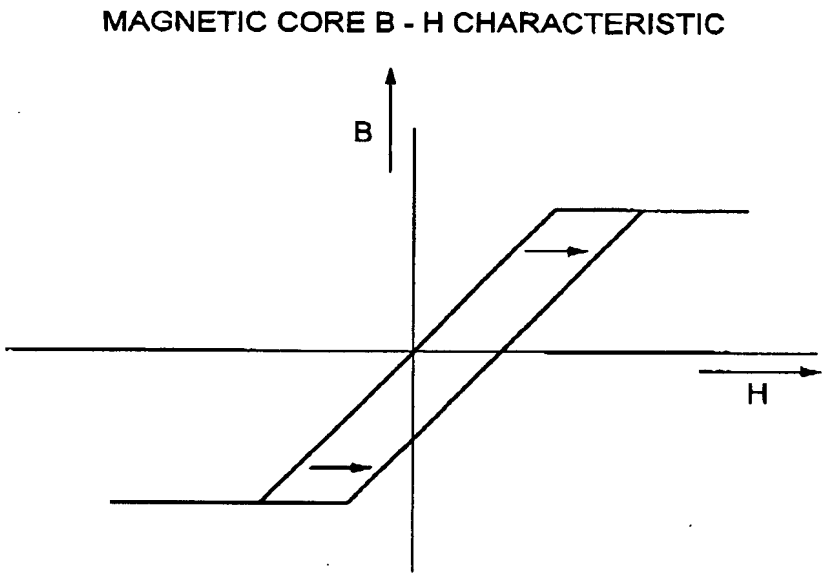


FIG.8

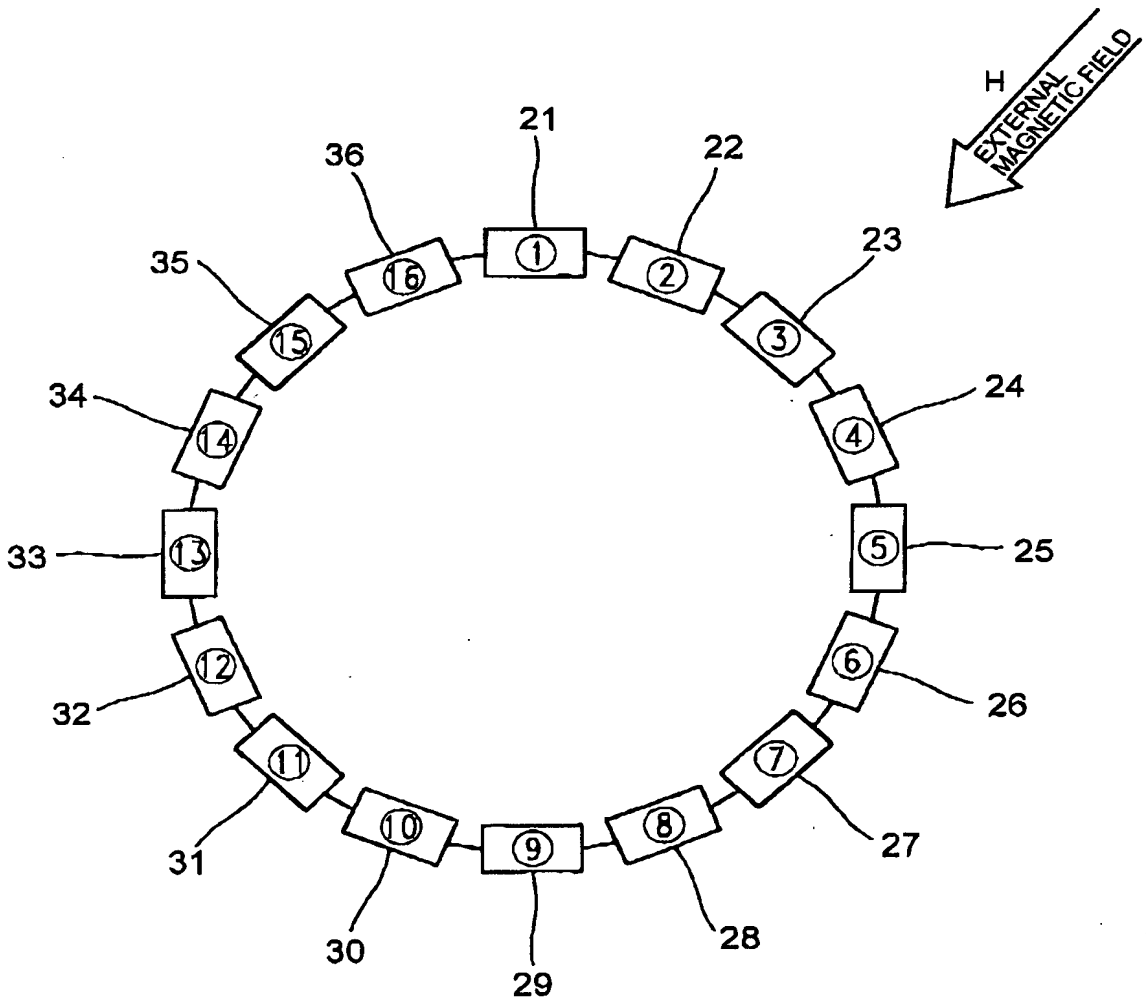
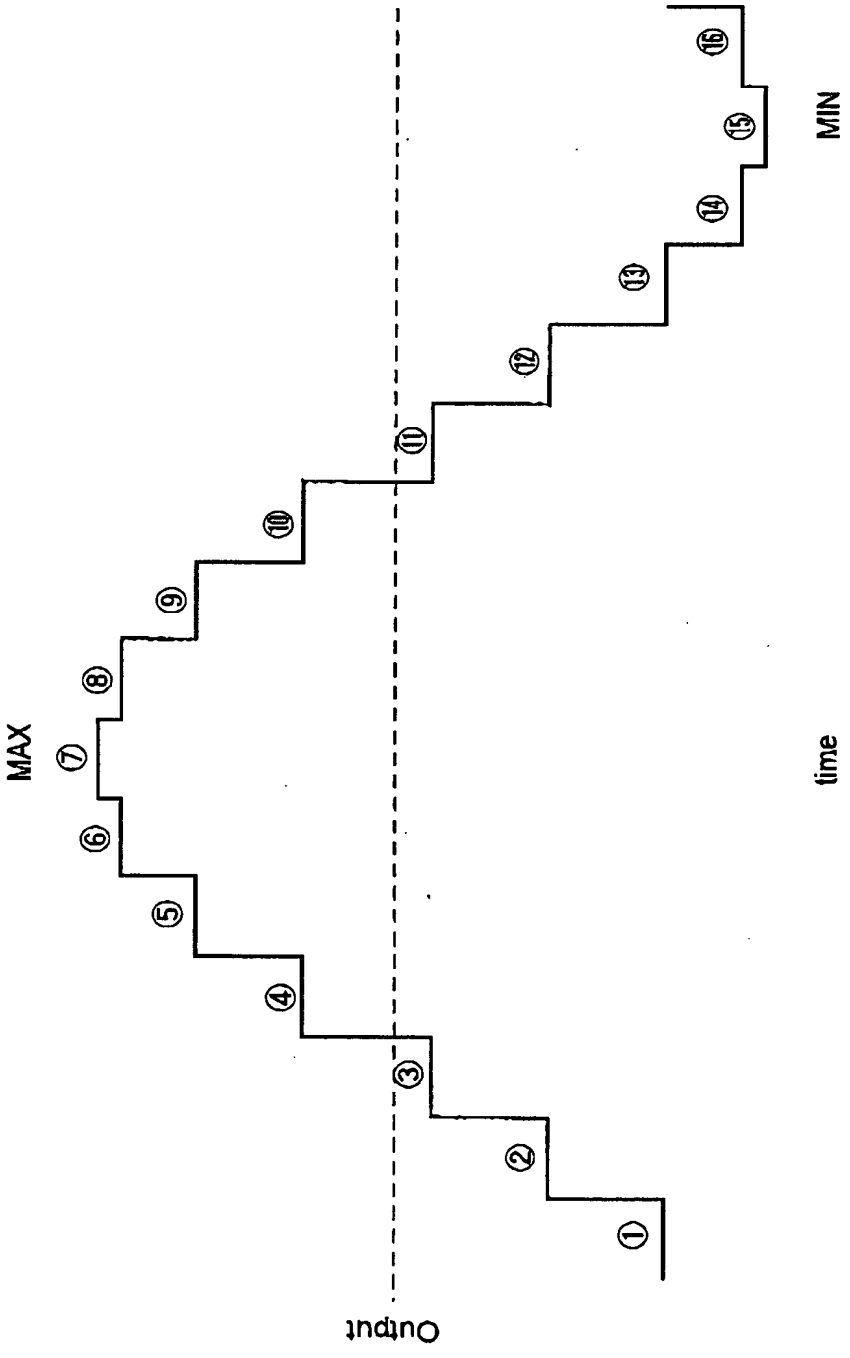

H
EXTERNAL MAGNETIC FIELD
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

FIG.9



OUTPUT MAX:⑦ → PARALLEL TO EXTERNAL MAGNETIC FIELD
OUTPUT MIN:⑮ → INVERSELY PARALLEL TO EXTERNAL MAGNETIC FIELD

FIG.10

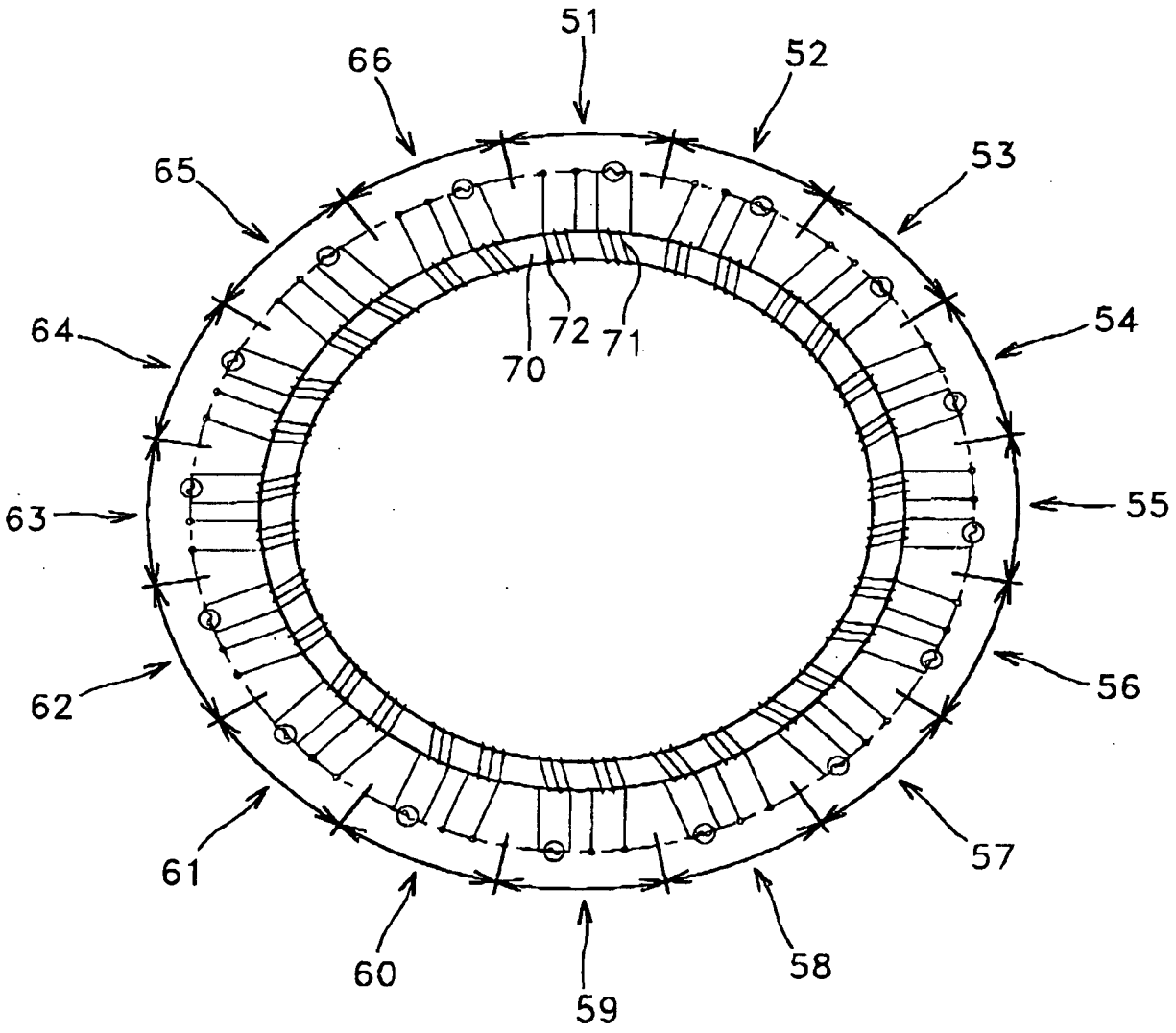


FIG.11

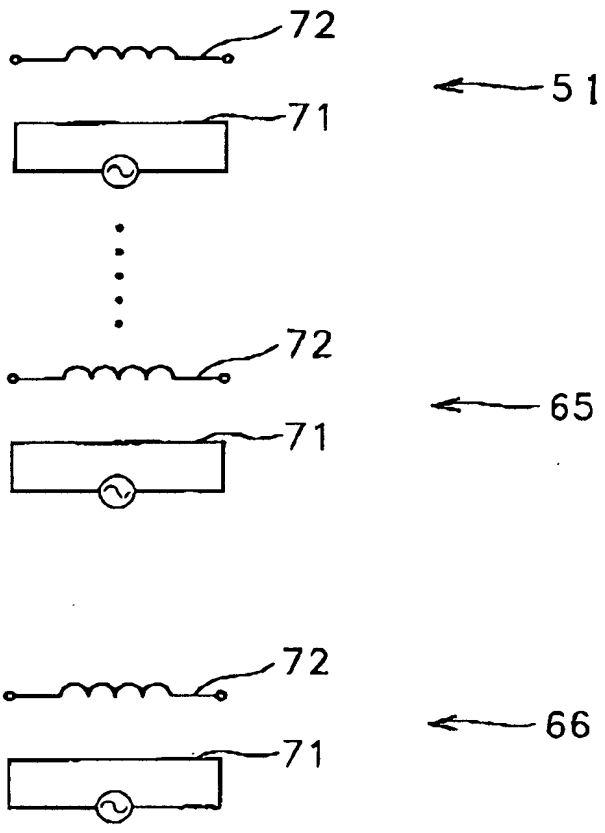


FIG.12

80

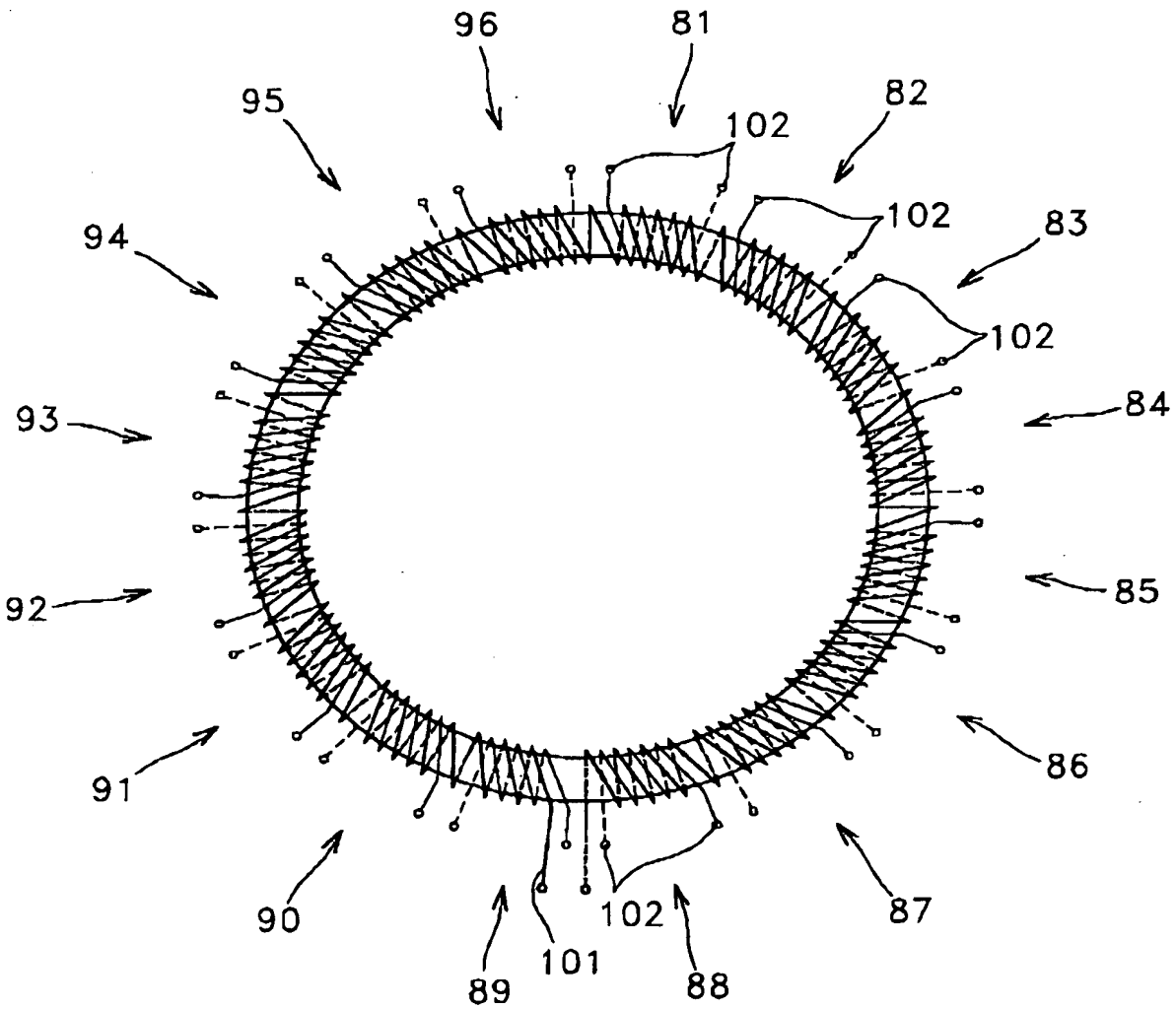


FIG.13A

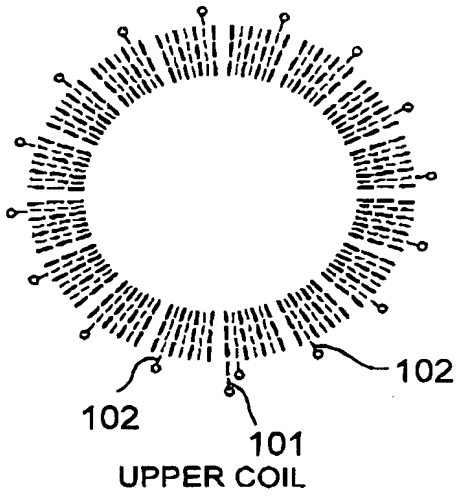


FIG.13B

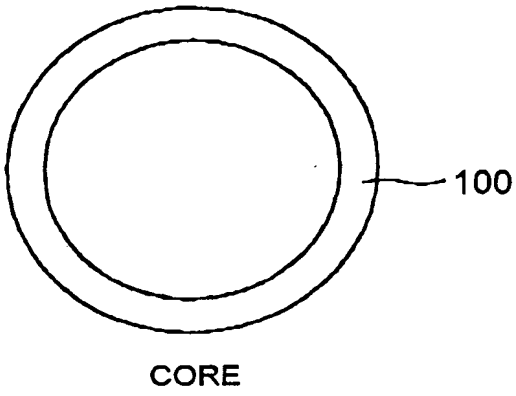


FIG.13C

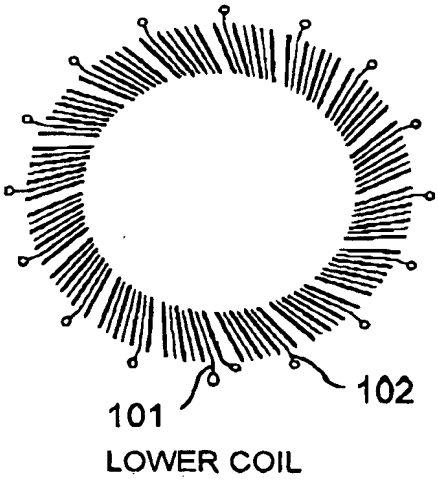


FIG.14

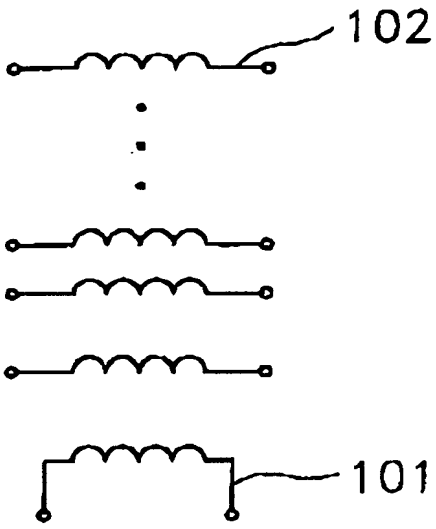


FIG.15

110

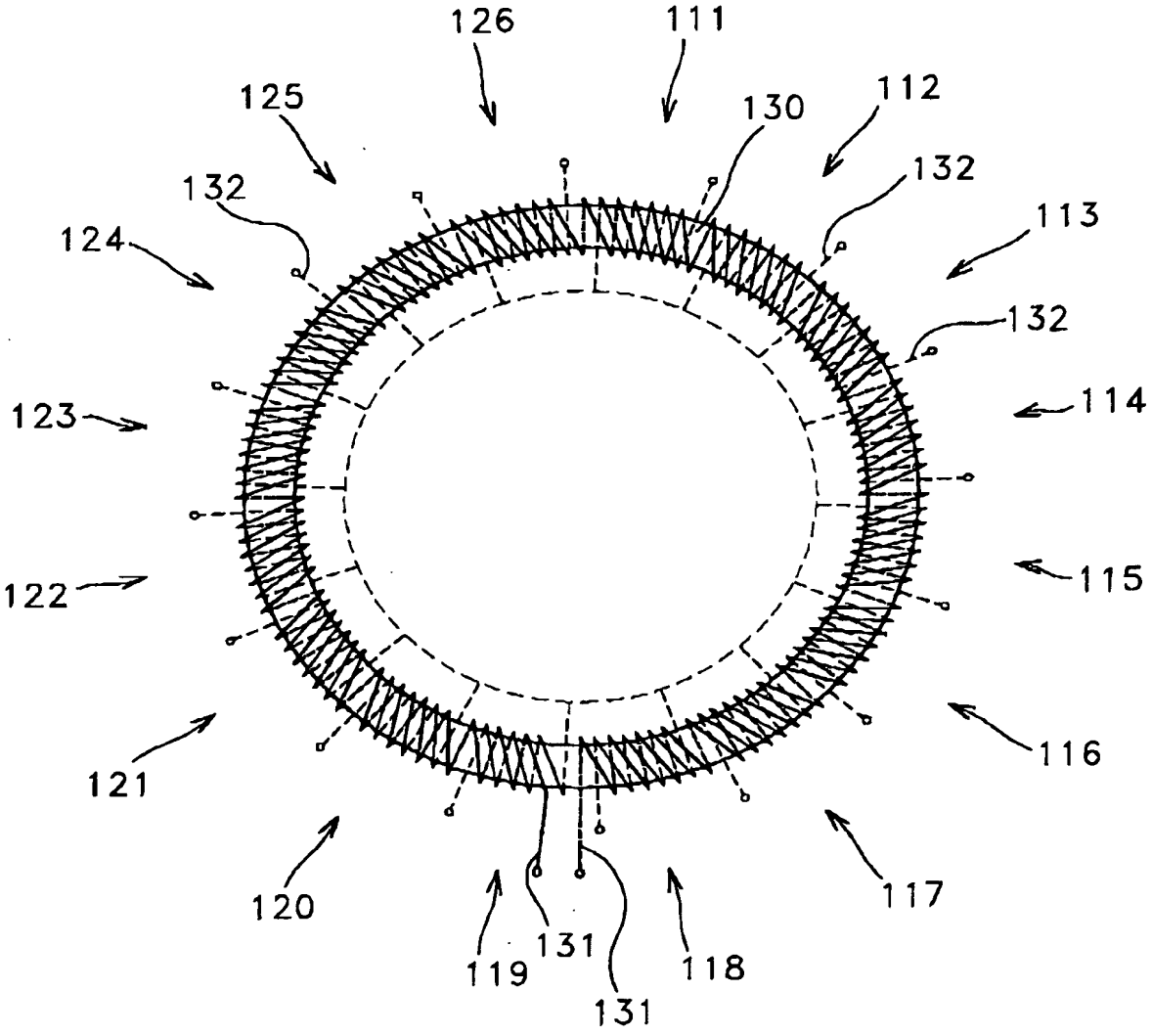

126
111
125
130
112
132
132
124
113
132
123
114
122
115
121
116
120
117
119
131
131
118

FIG.16A

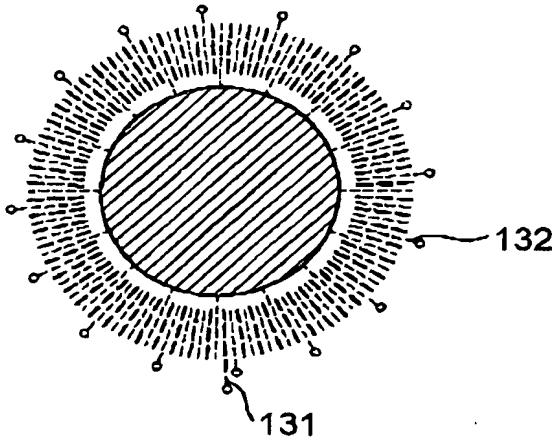


FIG.16B

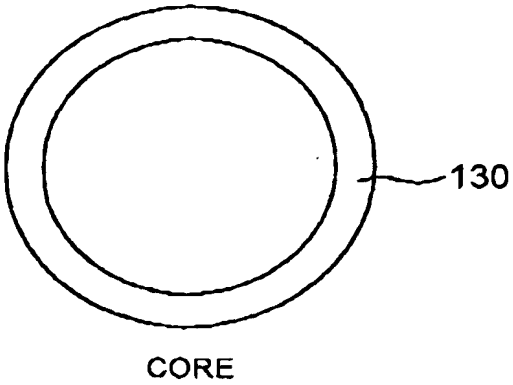


FIG.16C

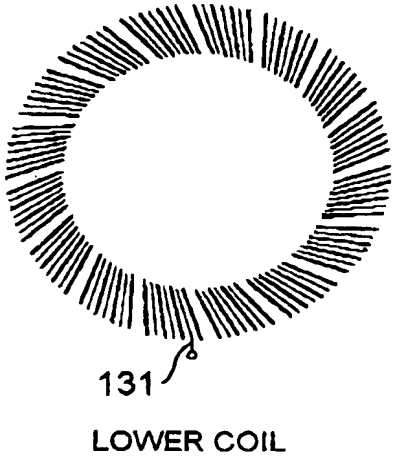


FIG.17

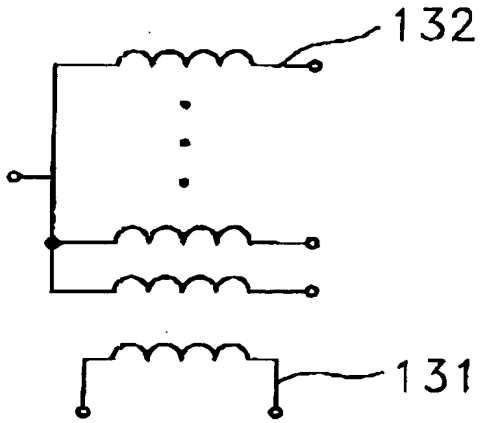


FIG.18

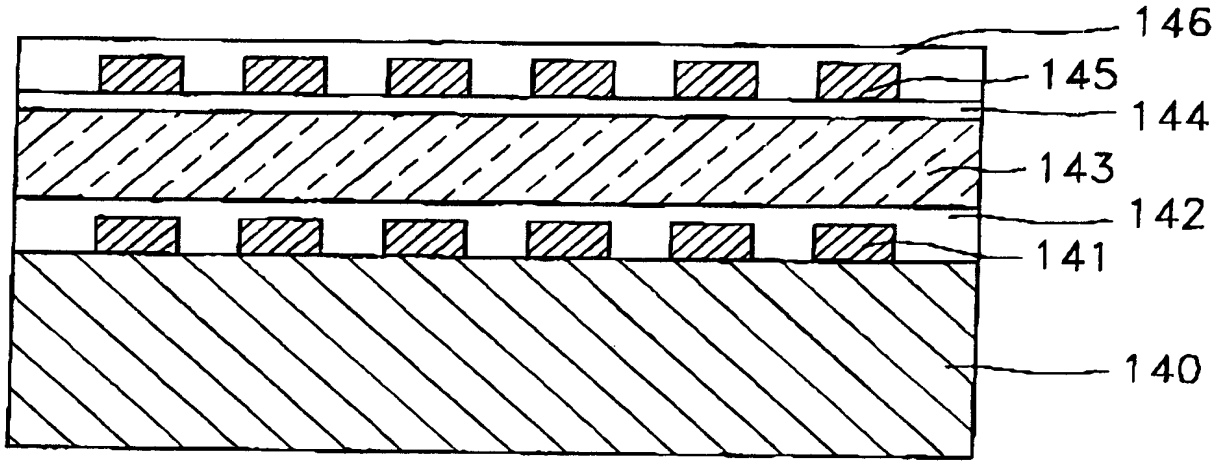


FIG.19

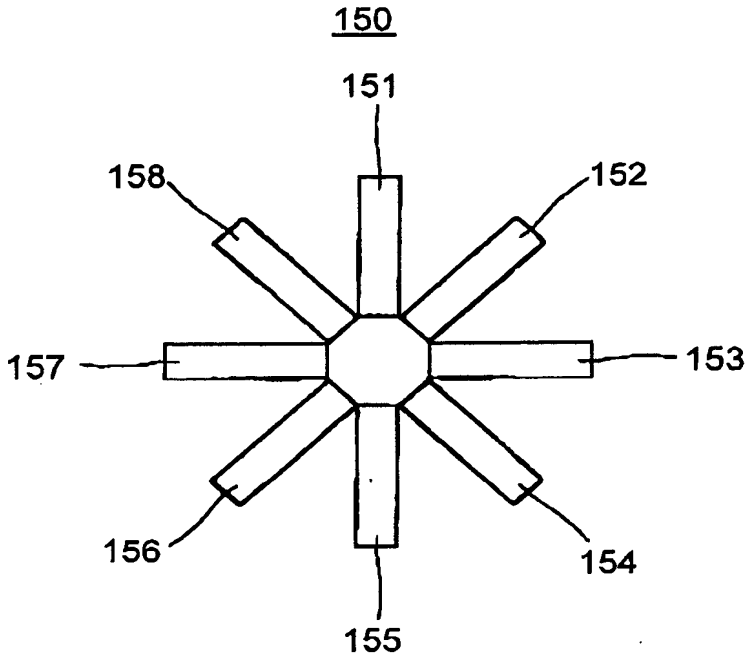

150
151
152
153
154
155
156
157
158

FIG.20

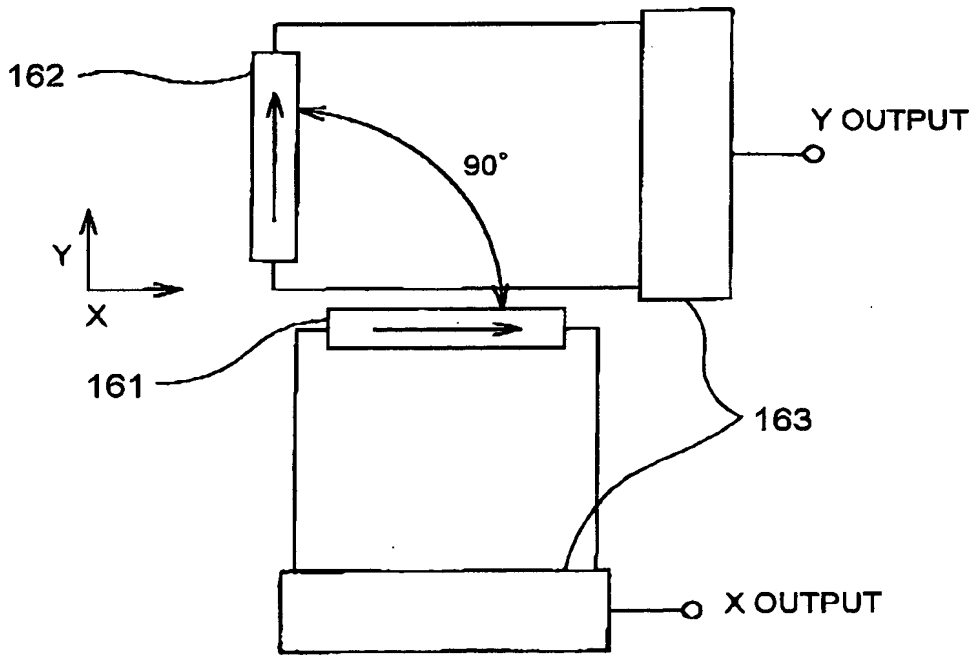

162
90°
Y OUTPUT
Y
X
161
163
X OUTPUT

FIG.21

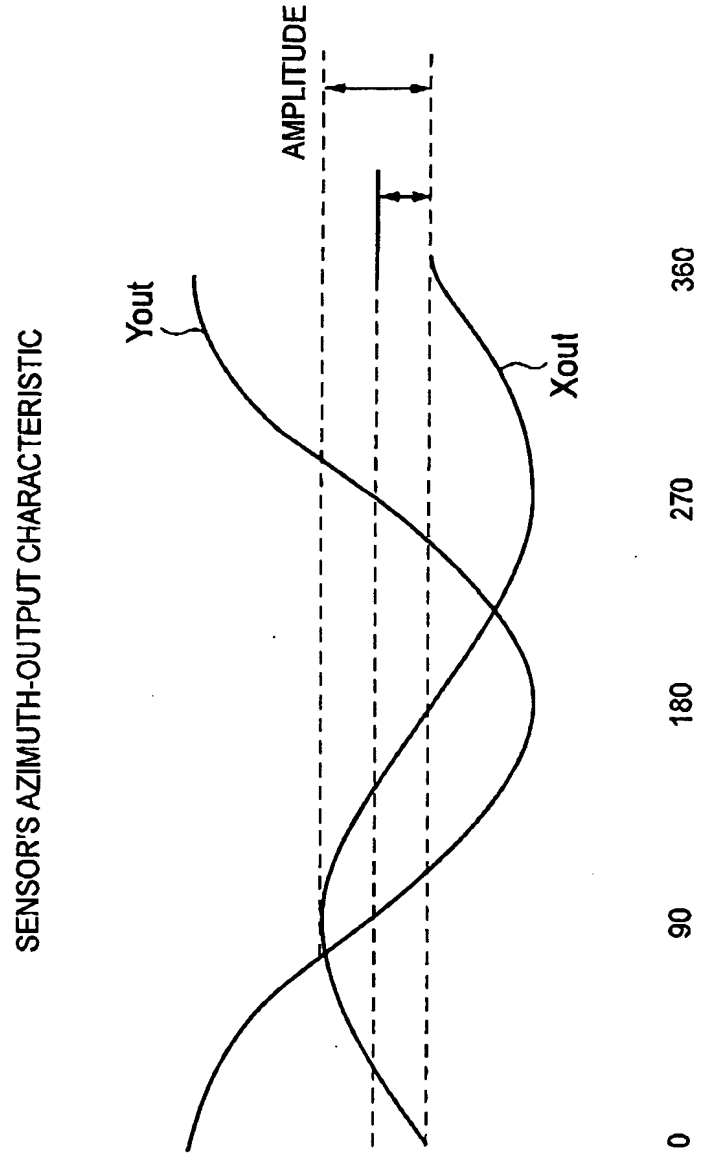
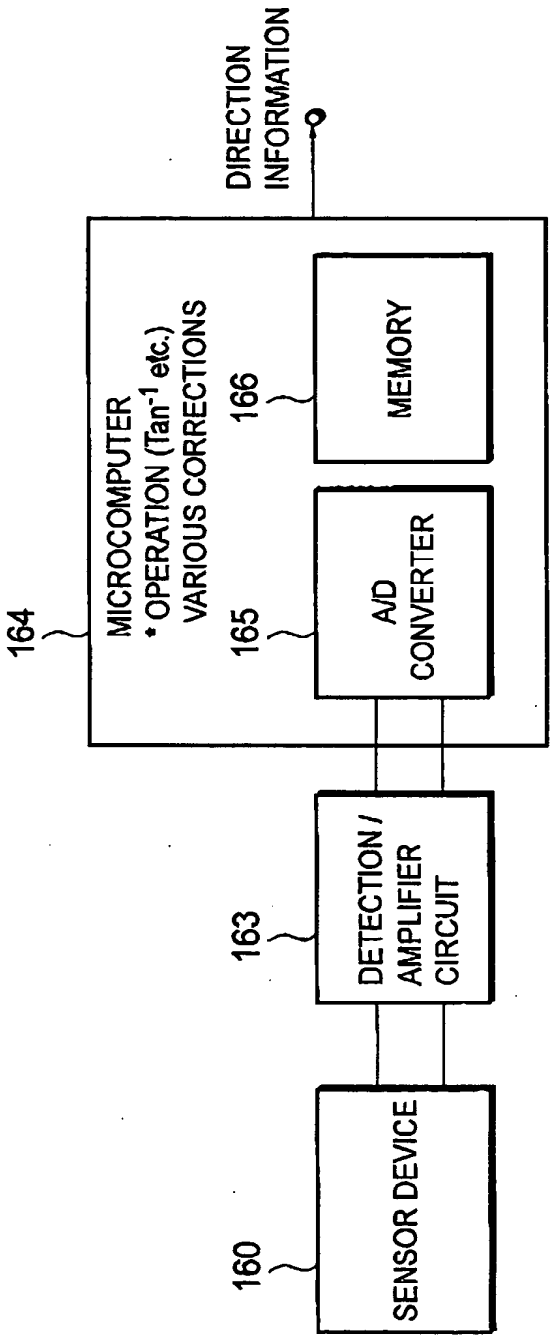

SENSOR'S AZIMUTH-OUTPUT CHARACTERISTIC
AMPLITUDE
Yout
Xout
0
90
180
270
360
AZIMUTH [DEG]

FIG.22


DIRECTION INFORMATION
164
MICROCOMPUTER
* OPERATION (Tan^{-1} etc.)
VARIOUS CORRECTIONS
165
A/D CONVERTER
166
MEMORY
163
DETECTION / AMPLIFIER CIRCUIT
160
SENSOR DEVICE